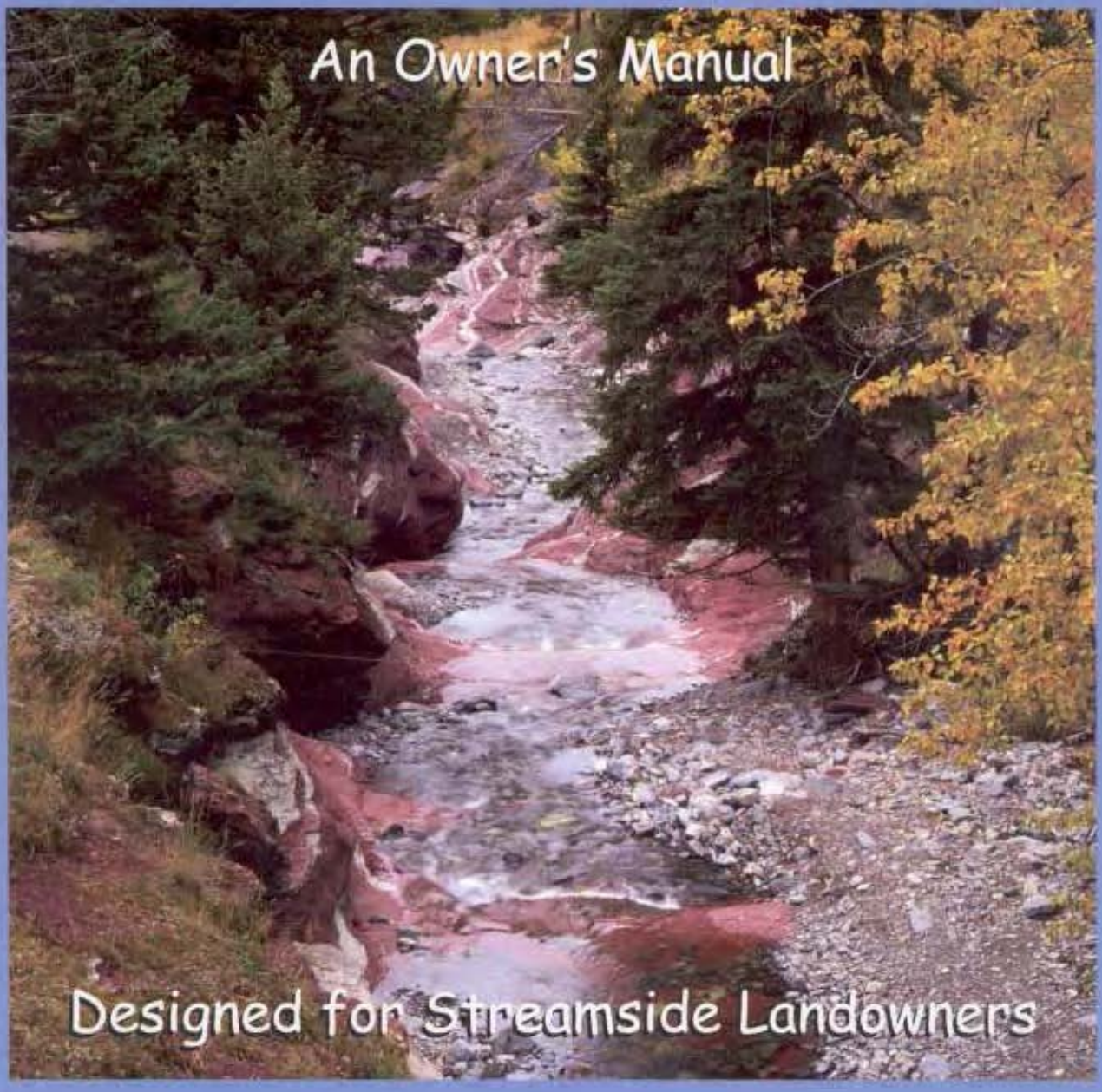
STREAM CARE GUIDE



Stream Care Guide

An Owner's Manual for Streamside Landowners

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Soil and Water Conservation District
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Introduction.....

Riparian Zone - An area of land adjacent to a water body. Often vegetated, it provides a buffer between the land and the water.

Most of the streams that run through our communities are out of sight and out of mind. We fail to recognize the vital link they have to our lives. In most communities streams have become merely receptacles for stormwater runoff and dumping grounds for everything from yard materials, such as grass and leaves, to large household appliances and even abandoned automobiles. To many residents they are simply a means to convey stormwater off property and streets in the quickest fashion possible. Often the only time we turn our attention to them is when there is a threat to our personal property. We fail to see how we have suffered great losses from neglect long before our property started showing signs of erosion.

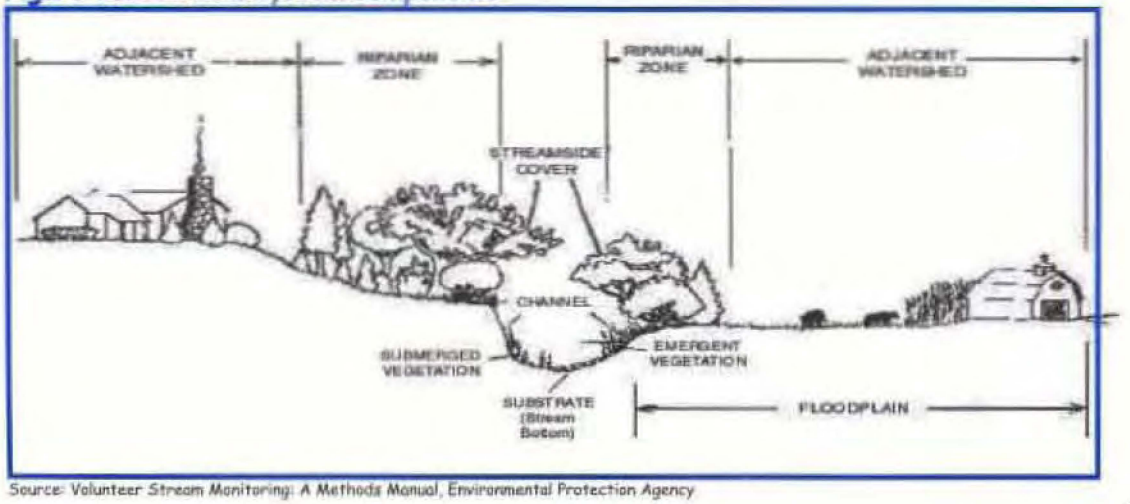
A healthy stream can be a wonderful asset to any property. It has aesthetic value that can add real money value to your property. A healthy stream can improve the water quality in a watershed, making the water we drink safer. It can provide habitat and greenways for animals to travel through. While it does provide stormwater runoff relief it also can be an avenue for recharging groundwater.

On the other hand, an unhealthy stream can lower the value of your property. In fact, if stormwater runoff is not managed correctly a creek can become a raging torrent that erodes streambanks, destroys vegetation, and deepens streambeds so badly that it threatens actual property. Additionally, when lawn and household products are not applied properly, the water quality of the watershed can be degraded and important habitat for animals can be lost.

The goal for this guide is to give streamside landowners the information they need to assess the health of their stream while providing the tools they need to correct problems they may find. It also provides guidelines on activities that adversely affect a stream and offers some healthy alternatives.

Watershed - An area of land that drains (sheds) water into a common water body, such as, a stream, river, lake or wetland.

Figure 1.0 *Stream System Components*



Source: Volunteer Stream Monitoring: A Methods Manual, Environmental Protection Agency

Stream Health

Streams in urban settings are often altered to fit into the designs of a new development, such as a new shopping center, subdivision or business park. Some streams have been straightened and lined with concrete, which increases their water velocity (speed of flow) and allows little water infiltration to the soil. Surfaces that prevent water from soaking into the ground (impervious surfaces), such as streets, driveways, rooftops and parking lots, increase the volume of runoff water to the stream.

It is important to remember that with streams every action causes a reaction. Changes in the stream channel, combined with increased stormwater runoff from new development, can create a dangerous situation in any stream. In order to handle the increased flows and velocities, a stream must widen its banks and deepen its bed. This results in streambanks that are very steep. Often the stream's normal flow dries up and becomes a raging torrent within minutes of rainfall.

New development puts a series of stresses on the stream. During construction, streams become victims of excessive sedimentation. Lack of erosion control measures or poorly implemented controls lead to soil runoff into the stream, choking off aquatic life and degrading water quality.

Once development is completed, stormwater runoff can flow off the land at a faster rate, draining the land in hours rather than storing water and slowly releasing it over a period of days. This is because new development changes land use in the watershed from expanses of forestland and/or fields to a patchwork of numerous impervious surfaces connected by lawn. Prior to new development, stormwater would have filtered into the ground or would have been intercepted by leaves to be evaporated back up into the atmosphere. After new development, the water flows off impervious surfaces into the nearest stormdrain and then directly into a stream. This fast drainage pattern is by design, not accident, and it can and should be controlled. Recently, in the last decade, stormwater regulations have been established for new development. These regulations state that stormwater runoff for land under development will be stored and then slowly released at the same flow rate seen prior to land-use changes; however, the volume of water may increase. This means that the volume of water will be greater after the land-use change and that water will flow for a longer duration, but the water cannot flow at a faster rate. Check with your municipality for stormwater regulations in your area.

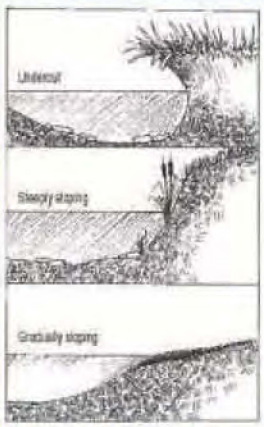
Additionally, our daily activities in the urban environment can adversely affect the health of a stream. Activities such as gardening and landscaping, household practices, and even car maintenance can lead to the release of pollutants that can harm our water supply. These pollutants are known as nonpoint source pollution because they come from numerous points in the watershed but cannot be traced to a single source such as a pipe from a factory (point source pollution).

Still, streams are resilient. With the proper care and restoration techniques a stream that has been subjected to stress can recover and even thrive in an urban environment. It is critical that as a riparian landowner you take

responsibility to assess the health of your stream.

Becoming familiar with your stream is one of the best ways for you to protect your property in the event that changes take place in your watershed. Your stream should be monitored for problems at least three times a year. Ideally, you should check your stream after every large rain event to see if any problems have arisen as a result of flooding or rapidly rising, fast flowing water.

Figure 1.1 Types of Streambank Shapes



A slightly undercut bank is resistant to erosion and provides habitat for aquatic species.

A bank with a greater than 30% slope is vulnerable to erosion.

A gradually sloping bank is resistant to erosion but it doesn't provide needed streamside cover.

Source: Volunteer Stream Monitoring A Methods Manual, Environmental Protection Agency

Signs of a Healthy Stream

Water quality and flow:

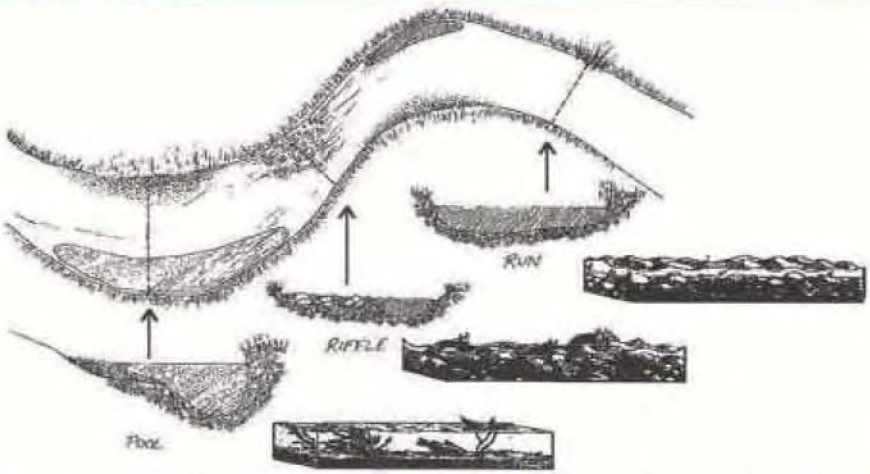
- Clear water free of contaminants and excessive algae
- Riffles, where water is flowing fast and turbulent as it moves over rocks and gravel
- Pools, where water moves slower
- Runs, where water is deep and fast-moving with little or no turbulence
- Varied flow cycles throughout the seasons
- Cool water temperature

Variety in flow allows the stream to regulate its energy while providing for water quality and diversity of habitat for fish and other aquatic species.

Streambeds and banks:

- Stable streambanks with minimal erosion
- Streambanks vegetated with diverse native species
- Streambed and channel shaded from riparian tree canopy

Figure 1.2 Cross Section of a Riffle, Pool and Run



Stream flow should vary along a stream with riffles, where flow is fast and turbulent over rock and gravel; pools, where flow is deep and slow; and runs, where flow is deep and fast with little turbulence.

Source: Volunteer Stream Monitoring: A Methods Manual, Environmental Protection Agency

- Few or no pipes dumping stormwater directly into stream, especially at top of bank

Generally streambeds consist of rock or gravel of various size. They should be free of sediment but streambeds can vary along the reach of a stream, changing from bedrock to cobblestone and gravel and even to sandy or sediment bottoms in some stretches of the stream.

Plants and wildlife:

- Vegetated riparian corridor, minimum of 25 feet on each side of the stream
- Riparian corridor protected during and after new development
- Riparian trees to provide streambank stabilization
- Tree canopy to cool water, provide habitat
- Diverse native plant population that includes ground covers, herbaceous plants, shrubs and trees
- Thriving fish, amphibian, and aquatic insect populations
- Leaf litter, small branches, and fallen logs within the streambed and along the banks

Life within the stream indicates water quality. The more diverse the life within the stream is, in both number of organisms and types of species, the greater the water quality of the stream. Diversity in plant material also gives the stream the ability to better withstand stresses. Leaf material, branches and logs within the stream provide diversity in habitat allowing the stream to support more types of species.

Signs of an Ailing Stream

Water quality and flow:

- Green water indicates too much algae
- Orange water indicates the presence of iron or acidic runoff from mining activities
- Foam more than three inches high that doesn't break up easily indicates pollution from detergents or excess nitrogen
- Brown or muddy water indicates sediment or suspended solids
- Shiny or rainbow-colored water surface indicates the presence of petroleum products or antifreeze
- Odor of rotten eggs indicates sewage waste
- Fishy smell indicates excessive algal growth or dead fish
- Chemical smell indicates that harmful toxins have been dumped in the stream, such as dry cleaning fluid and paint solvents
- Chlorine smell indicates overchlorinated water treatment or swimming pool discharges into stream
- High water temperature
- Reduced or absent water flow with flash-flood conditions during rain

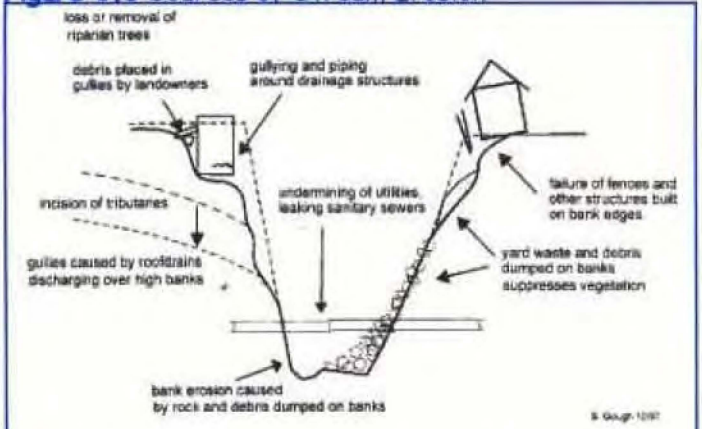
Excessive algae growth is caused by the runoff from fertilizers. Too much algae affects water quality by covering the water surface and preventing the sun from reaching other aquatic plants. Additionally, as the algae die, organisms that work to break it down use oxygen from the water. This reduces the amount of oxygen available for other aquatic organisms.

Water temperature also affects the oxygen level in the water. Water with a high temperature has less oxygen available for fish. This limits the types of species that can live in the water. Sport fish require fairly cool water temperatures while less desirable fish species can thrive in water with a higher temperature.

Streambed and banks:

- Stream channel has been straightened or artificially located
- Stream channel has been lined with concrete
- Debris such as concrete slabs, old tires, or construction materials dumped on banks
- Stream banks show signs of severe erosion or areas of landslides
- Severely exposed soil and tree roots
- Stream banks extremely steep (greater than 30 degree slope)
- Streambed has been deeply incised (cut down), indicating streambed is lowering
- Sediment has impeded stream flow, indicating streambed is rising
- Still water with total absence of riffles or fast water given stream size
- Litter, grass clippings, leaves, trash, and other debris dumped on banks or in stream channel
- Heavy loads like sheds or wood piles on the top of the streambank

Figure 1.3 Sources of Stream Erosion


loss or removal of riparian trees
debris placed in gullies by landowners
gullying and piping around drainage structures
incision of tributaries
undermining of utilities leaking sanitary sewers
failure of fences and other structures built on bank edges
gullies caused by rooftrains discharging over high banks
yard waste and debris dumped on banks suppresses vegetation
bank erosion caused by rock and debris dumped on banks

Stream erosion can be caused by debris, such as yard waste and garbage dumped on banks; building fences and other structures on banks; water flowing over banks; rock, concrete, etc., dumped in the stream, and pipes placed in the stream or on streambanks.

Plants and wildlife:

- Lack of diversity in plant, animal, and aquatic species
- Invasive non-native plants that compete with native species in the riparian corridor
- Diminished or absent fish, amphibian, and aquatic insect populations
- Small or non-existent riparian corridor
- Barren streambanks

Of course stream characteristics vary depending on where you live. A healthy stream can also be an intermittent stream, one that does not have water flow year-round. Water flow and characteristics of the streambanks, streambed, vegetation and wildlife also vary naturally along the length of a stream. A thriving stream ecosystem is a diverse habitat where you will encounter a range of conditions. You need to understand how your stretch of the stream and your property fit into the overall ecosystem.

Although you can play a key role in stream care, a stream's health is also affected by activities far beyond the boundary of your property. Within the watershed, as natural surfaces are paved and developed, less rainfall percolates into the ground and more water flows directly into the stream system from streets and stormdrains. Stormdrains generally receive no wastewater treatment. Almost always, this urban runoff carries debris and pollutants that pose significant problems for streams. While you may have little control over the entire watershed, your diligence and cooperation with other streamside neighbors can prevent and reduce activities that harm your stream.

For those stream owners who are serious about monitoring their streams the Environmental Protection Agency (EPA) Office of Water offers a publication called *Volunteer Stream Monitoring: A Methods Manual.* This manual can be viewed on the EPA website: www.epa.gov/owow/monitoring/volunteer/stream/. Monitoring training and equipment can be obtained through the Missouri Stream Team program, a partnership between the Missouri Department of Natural Resources, the Missouri Department of Conservation and the Conservation Federation of Missouri. For more information call 1 (800) 781-1989, or visit their website: www.mostreamteam.org.

Keeping Your Stream Healthy

One quart of oil poured down a stormdrain can contaminate one million gallons of drinking water.

Petroleum product and antifreeze disposal:

Even in low concentrations these automotive products are extremely toxic to fish and other aquatic wildlife. Never dump gasoline, motor oil, antifreeze, battery acid, or other automotive fluids into a stream or stormdrain.

Place used motor oil or antifreeze in sturdy, sealed containers, with the caps taped down and recycle them through your local collection program or recycling depot. Many communities have curbside oil recycling collection or antifreeze collection services. Check with your local recycling agency for more information about recycling these products.

You can recycle household chemicals by giving them to schools or local institutions that can use them.

Paints, thinners, and solvents disposal:

Improperly disposed paint products also cause harm to fish, wildlife, and people. Completely use up paints or share leftovers with a friend or neighbor. Small amounts of leftover paint can be air-dried in cans and discarded in the garbage. Dispose of unusable paints and paint products at your local household hazardous waste facility. Do not clean brushes in a gutter or near a stormdrain or stream. Use water-based latex paints whenever possible. They are less toxic than oil-based paints, thinners, and turpentine and they can be recycled. Paint thinners should be filtered and reused. Dispose of paint thinner and solvent residue at a hazardous waste collection facility.

To neutralize carpet odors sprinkle a mixture of 1 cup borax and 2 cups cornmeal or baking soda on carpet. Let sit for 1 hour and then vacuum.

Carpet-cleaning solution:

Never dump carpet-cleaning solution into a stream or stormdrain. These chemicals are extremely toxic. Dispose of them by flushing them down a sink or toilet. If you employ a carpet-cleaning company, make sure it does not dispose of the leftover water from carpet cleaning in a stream or stormdrain.

Car maintenance:

Avoid hosing down paved surfaces or washing your car on a paved driveway or street. Even biodegradable soaps are toxic to fish and wildlife. Wash vehicles on a lawn or unpaved area, or use a commercial car wash.

Hazardous fluid and pesticide spills:

Hazardous fluids from cars or pesticide spills should be cleaned up using dry clean-up methods. Do not spray with a hose. Use cat litter or other absorbent materials to remove spills from paved surfaces. Depending on the substance spilled, dispose of absorbent materials in the garbage or at a hazardous waste collection site. If you must use water in a final clean-up step, direct flow to a lawn area — not to the street, gutter, or stormdrain.

If you use a pool service, ensure that they use safe pool cleaning methods.

Pool and spa maintenance:

Chlorine and copper algaecides used in pools and spas are toxic to aquatic organisms and wildlife. Pool and spa water should never be drained to the street, gutter, or stormdrain. Contact your local wastewater treatment plant before discharging this water into the sewer line. Municipalities have varying rules on this practice.

The best way to drain your pool or spa is to let the chlorine dissipate by allowing the water to sit for up to two weeks and then drain onto landscaping. If you cannot allow the pool to sit, add sodium bisulfate in the amount suggested on the label. Do not use copper-based algaecides. Proper chlorinating should take care of algae problems.

Rain gutters and other pipes:

Make sure rain gutters and down spouts do not carry water directly into the stream. If your pipes are directed into a stream, consider redirecting the flow onto a grassed area to allow infiltration (see Protecting Stream Flow).

Runoff from roof surfaces contributes to the decline of stream health. Pipes projecting directly into a stream bank or flexible pipes allowed to hang over a streambank cause erosion. Consider using cisterns (tanks for storing rainwater) or rain recycling systems to capture roof runoff. This captured water can then be used to water lawn or garden areas.

If you have a pet, be sure to properly dispose of all pet waste. Pet waste is a major source of bacterial pollution in streams.

Yard waste disposal:

Never dump grass, leaves or tree limbs on the banks of the stream or into the stream. Large piles of grass clippings, leaves, and tree limbs will kill the vegetation, causing erosion on the streambank. Grass, leaves, and branches contain nitrogen and carbon that will encourage plant growth in the water. Too much plant material in the water will decrease the water quality.

To keep your stream clean, form a Stream Team.
Call 1 (800) 781-1989.

Trash and litter removal:

Unfortunately, some people think of streams as garbage dumps. You don't have to look far to find old streams littered with shopping carts, used appliances, mattresses, car parts, bottles, cans, plastic, Styrofoam, and paper litter. This debris can become a hazard during floods. It can also be a potential threat to our groundwater quality and provide breeding places for rodents and mosquitoes. If you need help cleaning up the stream, contact some of the organizations listed in Appendix C for ideas and assistance.

Call your municipality to find out when the next planned waste pick-up day will held in your area. Numbers are listed in Appendix C.

Be a zero-discharger:

A zero-discharger is someone who never throws away materials that can be reused. When you reuse and recycle paper, plastic, fluids, and other products, they never become waste products. Try to purchase reusable or recyclable materials whenever you can.

Underground storage tanks (UST):

If your home has UST for heating oil it is a potential source of water pollution. Early leak detection is your best protection against costly cleanups. A tank tightness test should be performed periodically, especially on older tanks and those near a waterway. Signs of a leak are unusual amounts of water in the tank, unusual odors in your water supply, petroleum in the basement, heating systems that malfunction, dead or dying vegetation near tanks, or an increase in fuel use.

Septic system management:

Maintenance is the best way to keep a septic system working properly for a long time. The following practices will help: know the location of your system components and keep heavy vehicles away; direct water from downspouts, roofs, etc., away from the disposal field; dispose of hazardous chemicals properly; and have a reputable contractor remove sludge from the septic tank every two to three years.

If you are having problems with your septic system, or you are planning to put in a new system, contact the USDA NRCS for their publication "Soil Evaluation for On-site Waste Disposal" (see Appendix C for numbers).

Household grease and oil disposal:

Never dump household grease or oil in the stream or into a stormdrain. They can enter the stream and decrease the oxygen content of the water, coat fish gills, and smother bottom-dwelling organisms. Food scraps contribute too much nutrient matter in the stream. Too many nutrients, especially nitrogen and phosphates, cause excessive plant growth. When the plants die they use up oxygen needed by fish and other organisms.

Cover and maintain garbage containers:

Open or leaking garbage containers are common causes of water pollution. Keep garbage can lids on at all times. Close dumpsters and place them under roofs. Cover them with plastic sheeting during rainy weather. Inspect dumpsters and garbage cans regularly for leaks, and repair or replace any that are not watertight. Return dumpsters to the trash hauling company for cleaning. Do not hose down garbage containers on paved surfaces that drain to the street or stream.

Stream Friendly Landscaping.....

The Riparian Corridor

The land-use practices in a watershed have a major impact on a stream. The first and last line of defense to protect streams against these impacts is the riparian corridor, the area of vegetation that extends from the stream channel up the banks and into the surrounding landscape. The ideal riparian corridor width is site specific but in general a 100-foot area on either side of the stream is recommended. Ideally, the corridor should never be less than 25 feet. Realizing that space in already developed urban yards is limited, landowners should devote as much yard as possible to the riparian corridor.

A healthy riparian corridor doesn't mean that the stream won't change in response to changes in the watershed; it simply provides a buffer that will mitigate some of the activities in the watershed while allowing the stream room to change. Streams naturally change over time; however, the activities that we undertake in the watershed increase the severity and amount of change that a stream will undergo. Proper planning and study of possible impacts on the stream before implementing any proposed developments in the watershed are some of the best methods to help a stream respond to change.

The riparian corridor provides a link between the land and water, and it performs many critical functions. The vegetation acts as a buffer, trapping and filtering sediment, nutrients, and chemicals that are carried in runoff and shallow groundwater to the stream. This leads to water quality benefits for humans and animals. Tree roots stabilize banks while branches shade the stream, cooling the water temperature. Cooler temperatures allow water to hold more oxygen and therefore support more life. Plant stems and roots slow water velocity and keep the soil porous so that it can absorb more water. Fallen trees and branches also slow the flow of water and provide habitat for aquatic species. Perhaps most important to homeowners is the buffer's ability to hold water, thereby reducing flooding and aiding in deep percolation of water to replenish groundwater supplies.

Riparian Corridor Zones:

One way to look at the riparian corridor is to break it down into three main zones: undisturbed forest, managed forest, and transition. These zones are defined on the basis of the type of plantings and the level of human activity that is acceptable in each. For more information on the exact width for your stream contact the USDA Natural Resource Conservation Service (see Appendix C for phone numbers).

Zone One: Undisturbed forest

Zone One is from the edge of the high-water mark on the streambank on both sides of the stream to a minimum of 25 feet. This zone is undisturbed forest area. It should be composed of diverse, native woody shrubs and trees.

Ideally, human activities in this zone should be minimal. Activities should be limited to the replacement of dead trees and vegetation, and the removal of invasive non-native species, such as purple loosestrife and kudzu. (Appendix B for a listing of suitable plants)

Zone Two: Managed forest

Zone Two is a managed forest area where more intensive landscaping practices can take place. This zone can vary in width, depending on the size of the stream and the nature of activities planned for this area. It can be an area for limited harvesting of wood or forest products. Any trails or paths planned along the stream corridor could be located here or in Zone Three.

Proper lawn care will improve the water infiltration rate and holding capacity of your soil, resulting in less run-off to your stream.

Zone Three: Transition

Zone Three is a transition zone and ideally comprises deep-rooted native grasses, plants, and shrubs. Since native shrubs and plants use less inputs, such as fertilizer, pesticides, and water, they will require less maintenance than ornamental species. Ornamental non-native species should be planted closer to the home so that they are closer to a water source when they require watering. This zone acts as a buffer to yard runoff because it will absorb excess nutrients from the lawn area adjacent to the house.

Landscaping for a Healthy Stream

When landscaping for a healthy stream there are two main goals that you want to achieve. The first is to reduce runoff from your land to the stream by increasing deep infiltration of water. This can be achieved with proper lawn mowing and watering practices, regular aeration, and the addition of organic material to the soil. The second is to reduce the pollutant load off your land into the stream by using stream friendly, beneficial land management practices in your landscape.

If you look at your home as the center of your land, the land immediately adjacent is usually an area of high traffic. Here you will have your highest input in terms of water, fertilizer, and chemical use. Turf grasses and plants that may need extra fertilizing and chemicals to control pests and disease should be planted only in this zone.

The size of this high input area should be minimized in order to protect your stream from excessive runoff of water, sediment, chemicals, and nutrients. Turf grasses have low infiltration rates and therefore allow greater water runoff to the stream. Additionally, turf grasses and some ornamental plants require chemical inputs that can be harmful to a stream's water quality. For these reasons, turf grass and high-maintenance plants should be kept to a minimum and planted close to the house only.

Use a mulching mower and leave grass clippings on your lawn to decompose, clippings provide 1.8 lbs. of nitrogen in one growing season. That is half of your lawn's yearly nitrogen requirement—for free!

Minimizing lawn in your landscape:

The turf management practice that is healthiest for your stream is to minimize the amount of lawn in your landscape. Turf lawn has a short root system of 3 inches or less compared to the root system of native plants, which can reach up to 10 feet or more. Generally, the runoff rate from turf lawns is very high while water infiltration is low. In some areas with severely compacted soils, the infiltration rate is almost zero.

One way to reduce turf areas is to create planting beds of perennial plants and shrubs, preferably native plants that are drought tolerant and suited to your site conditions. Once established, native plants will not need additional inputs of water, fertilizer, or pest controls, even during droughts.

Once you have determined the area of turf lawn you want in your landscape you should design turf areas with compact and rounded shapes. Small areas that have curves and appear more rounded will facilitate greater ease in lawn care, allowing more efficient mowing and watering.

Finally, avoid planting turf grass on slopes. The runoff rate is higher and it will make the slope more susceptible to erosion problems. Slopes are ideal locations for native grass, shrubs and trees. There are a multitude of planting choices for slopes that will meet your needs whether you prefer low-growing groundcover or shrubs and trees.

Studies have shown that letting your lawn grow taller can help eliminate weeds as effectively or even more so than by using chemical treatment.

Mowing:

Perhaps the biggest mistake that homeowners make in lawn care is mowing at a height that is too short for the grass type they have. The proper mowing height is essential to the health of your lawn for several reasons:

- Taller grass results in a deeper root system
- Taller grass shades the soil and reduces evaporation
- Soil moisture reduces the need for watering
- Taller grass shades out weed species
- Tall grass clippings supply most, if not all, of your lawn's nitrogen needs

Different turf grass types call for different mowing heights. Also, blade height differs with the season. When the days are long and hot you should let the grass grow taller so it will shade the soil and help retain moisture. See Table 2.0 for the proper mowing height for the type of grass in your lawn.

Table 2.0

Seasonal Mowing Height

Grass Type	Spring	Summer/ Shade	Fall
Kentucky bluegrass	2 1/2	3 1/2	2 1/2
Fine fescue	2	3	2
Tall fescue	3 1/2	4	3 1/2
Perennial ryegrass	2 1/2	3 1/2	2

Fertilizers:

Many people want a lawn that is dark green and lush and they often overfertilize with fertilizers that are high in nitrogen in order to achieve that effect. Overfertilizing your lawn can actually put your lawn at risk for disease while endangering the health of your stream. Too much fertilizer or fertilizer applied at the wrong time can lead to many problems such as:

- Excessive leaf growth
- Shallow roots
- Thatch buildup
- Increased susceptibility to disease
- Need for frequent mowing
- Excessive weed growth
- Chemical runoff into streams

Lawns need three major nutrients: nitrogen (N), which encourages green leafy growth, phosphate (P), which benefits root growth, and potassium (K), which encourages vigor and disease resistance. These nutrients are most often provided through the use of fertilizers. They make up the N-P-K ratio you see listed on fertilizer packages. The ratio is the percent of each nutrient in the product, so an N-P-K ratio of 12-3-1 means that the product is 12 percent nitrogen, 3 percent phosphate, and 1 percent potassium. (See Table 2.1 for lawn fertilizer application rates.)

Lawn fertilizers come in three basic types: synthetic fast-release, synthetic slow-release and organic (here the use of organic is used to mean non-manmade). A fertilizer is called fast-release when its nutrients dissolve in water (water-soluble). Fast-release fertilizers are often very high in nitrogen (N) content.

According to Rodales's 'The Chemical Free Lawn', studies at the agronomy department of Alabama Polytechnic University have shown that fully half of all fast-release, water-soluble fertilizers leach out of the soil.

Table 2.1

Fertilizer Schedule

Grass Type	Total Nitrogen per year*	Apply at recommended rates**	
		May	Sept/Oct
Kentucky bluegrass	2 or 3	x	x
Red fescue	2	x	x
Bluegrass/red fescue mix	2 or 3	x	x
Tall fescue	3 or 4	x	x
Ryegrass	3 or 4	x	x

*lbs. per 1000 sq. ft

**apply one pound in spring and split the rest of the application between the fall months

Slow-release fertilizers must be broken down by soil microorganisms before their nutrients are available to grass plants. They provide nutrients over time, rather than all at once like fast-release fertilizers. Organic fertilizers are derived from plant and animal material as well as rock minerals and are therefore slow-release. Also on the market are synthetic fertilizers that contain nitrogen in both fast- and slow-release forms. The slow-release component is coated so that it will break down slowly. These fertilizers often contain both chemical and organic components.

The most commonly used fertilizers are chemical (synthetic) fertilizers. Most of these are chemically synthesized from nitrogen extracted from the air; this method uses considerable amounts of energy. Another synthesizing method is treating rock minerals with acid. The largest portion of a bag of synthetic fertilizer is actually a carrier or anti-caking material. In a one hundred-pound bag as much as eighty pounds could be non-fertilizer material. See tables 2.2 and 2.3 for listings of common synthetic fast- and slow-release fertilizers.

The most popular fertilizers on the market are fast-release fertilizers. Commercial lawn care companies often use liquid chemicals that are fast-release. Many popular products for sale at garden centers, often in granular form, are also fast-release fertilizers. Fast-release fertilizers provide dramatic results by greening up a lawn quickly because they are water-soluble and therefore immediately available for plant use. However, the lush green is illusionary in that it hides problems that often lie below the surface. According to "The Chemical Free Lawn" fast-release fertilizers can cause a host of problems, especially if they are used improperly because they:

- Wash away (leach) from the soil quickly
- Runoff into streams or groundwater
- Burn grass when their nitrogen content is too high
- Provide no food for soil microorganisms or earthworms
- Repel worms because they acidify the soil
- Slow down biological activity in the soil
- Increase susceptibility to pests and disease
- Increase soil compaction
- Fail to replace organic material so that soil structure declines
- Reduce water-holding capacity of the soil

Table 2.2

Fast-Release Fertilizers (water-soluble)
Ammonium sulfate
Ammonium nitrate
Ammonium phosphate
Calcium nitrate
Urea

Table 2.3

Slow-Release Fertilizers (synthetic)
Methylene urea
Urea formaldehyde
Isobutylidene diurea (IBDU)
Sulfur or polymer coated urea

- Lead to greater use because over time chemicals leach more readily

Ensure that your lawn care service performs a soil test before applying chemicals to your lawn. Save money and pay only for fertilizer or pesticide applications your lawn needs.

Unlike fast-release fertilizers, organic fertilizers release their nutrients over time and provide moderate rates of nitrogen. This means they:

- Provide food for both soil and plants over time
- Improve the soil structure
- Build up the soil water infiltration rate
- Increase water-holding capacity of the soil
- Make the lawn healthier

The first step in lawn care is to get a soil sample analysis from your County Outreach and Extension Office. Never apply fertilizers without knowing the nutrients needs of your soil. This analysis will tell you exactly the amendments, such as organic matter, lime, nitrogen, phosphates, and potassium, your soil needs and the proper application rates to use. Soil samples can be taken to your local county extension office. Low-cost soil test kits are also now available at garden centers.

Taking a Soil Sample:

Follow these steps to prepare a soil sample from your lawn that will accurately reflect the content of your soil:

1. Scrape away litter and plant growth from the surface.
2. Dig a hole that is at least four inches deep using a stainless steel trowel. Samples for garden areas would be to a depth of six inches.
3. Collect soil from the sides of the hole.
4. Repeat the sampling procedure at 10 - 15 different areas of your yard.
5. Be sure to sample from all types of areas within your lawn—shady, wet, dry.
6. Mix the samples in a clean plastic bag.
7. Place some of the soil mix in a single bag and take to your local county extension office.
8. Be sure to note that the soil is from lawn area.

Proper pH:

Sometimes, when fertilizer is applied to lawns, the desired result of a dark green lawn doesn't occur. When this happens people often apply more fertilizers; however, the problem most likely lies not with the fertilizer but within the soil itself. If the pH value of the soil is either too high (alkaline) or too low (acidic) the lawn will be unable to take up the nutrients we supply no matter how much we put on. Lawns like a pH that is between 6 and 7, so before you apply fertilizer you should first ensure that your soil falls within this range. Your lawn's pH should be tested every two years. If your pH is not within this range a soil test analysis will tell you exactly how much lime must be added in order to bring your soil back into the proper range of pH. The recommended lime application will be based on your soil type. Soil pH testing kits are now readily available at local garden centers and they are relatively inexpensive; however,

these tests do not tell you how much lime you will need and they may not be very accurate.

Your soil test analysis results will most likely suggest an application based on pure calcium carbonate per 1000 square feet. Lime comes in several forms. Some are fast acting while others take more time to change the pH level. Horticulture lime is usually of high quality so that you may directly apply the recommended pounds/1000 square feet directed on the soil test.

Applying fertilizer:

Fertilizer applications should always be done at the proper time of year for your grass type (see table 2.1 for fertilizer application times and rates). Additionally, extra caution should always be taken to keep fertilizer out of the stream and away from street, driveway, and sidewalk areas that lead to stormdrains. The package directions for the fertilizer you are applying should be followed carefully. Adding more fertilizer than recommended is never a good idea. This is true for all fertilizer, regardless of type.

To top-dress your lawn, spread a thin layer, less than an inch, of compost over the surface.

Never wait for rain to apply water-soluble fertilizers. Too much rain will just leach the product from the soil before it has a chance to be used by the grass. Instead, water in the product yourself if it needs water to be activated.

Organic fertilizers are now more available for lawn care. Many organic products have been introduced to the market that are packaged exactly the same as synthetic fertilizers and they require no special expertise or new costly tools. In fact, there are several organic lawn care companies operating within the Region.

Most, but not all, organic fertilizers supply both nutrients and organic matter to the soil. This benefits root growth by improving soil aeration, water and nutrient holding capacity, and soil texture. It is important that you make yearly soil amendments of organic matter. This is perhaps best done by top dressing with compost.

Proper watering will encourage healthy root growth in your lawn.

Unprocessed organic fertilizers (such as homemade compost) often don't have uniformity of size and shape so it is recommended that you use a drop spreader for application. Simply start at the lowest setting on your drop spreader and fill the spreader's hopper with the desired amount for the area. (See Table 2.4 for application rates.) Practice in a 100 sq. foot (10 x 10) area until you get the right application rate. After walking the area measure the product that is still in the hopper. If you have any product left, increase the setting and walk another area. If you run out of product before you completely cover the area you will need to find a spreader with a smaller setting.

For liquid applications of fertilizers, such as seaweed or fish emulsion, you will need a spray applicator. These are readily available, and range in price based on how convenient they are to use and how much liquid they will hold.

Watering:

Most homeowners give their lawns frequent but shallow watering. Too much water, or frequent but shallow watering will weaken the root system of the lawn, making it susceptible to pest and disease. A healthy root system will aid in water infiltration in your lawn, as well as, improve its water-holding capacity. It is best to provide one deep watering in the early morning hours as needed.

Table 2.4

Organic Soil Amendment Applications

Organic Amendment	Primary benefit	Average N-P-K* ratio	Application rate per 1000 sq. ft
Blood meal	Nitrogen	12-1-1	10 lb.**
Dry commercial compost	Organic matter	1-1-1	100 lb.**
Homemade compost	Organic matter	.5-.5-.5	1000 lb.**
Fish emulsion	Nitrogen	4-1-1	1 oz.
Seaweed*	Micronutrients		1 cup
Poultry manure	Nitrogen/Phosphorus	4-4-2	25 lb.**
Fish meal	Nitrogen	10-4-0	10 lb.**
Bat guano	Nitrogen	10-3-1	10 lb.**

*Nitrogen-Phosphate-Potassium
** amount needed to deliver 1 lb. of nitrogen
***recommended application is once in spring and again in fall

Benefits of Seaweed
- Lush, green lawn
- 50 micronutrients
- Nutrient uptake catalyst
- Enhanced resistance to fungal disease
- Increased tolerance to cold and drought

Watering during the day will allow too much evaporation and watering at night will make your lawn susceptible to disease.

Lawns require one inch of water per week. In most weeks this water will be provided by rain or by the water retained within the soil as reserves. It is best for your lawn if you water only when the soil's water reserves have run dry. Moisture meters for the lawn can be purchased from garden centers at a cost below twenty dollars.

Place a water bubbler on hose ends when watering plants. It slows the flow and allows for greater infiltration at a cost below $20.

If you don't have a meter you can tell the lawn has an insufficient moisture level by several signs, such as, foot prints that remain for hours and leaf blades that have turned a bluish purple. Another problem with watering is that most sprinklers apply water faster than a lawn can absorb it, wasting both water and your money. Few lawns can absorb even one-half inch of water per hour. To counteract this you may need to run the sprinkler for a short period and then turn it off for a time so that the water has time to soak into the ground.

Otherwise, while you might pump out one-inch of water, little of it will benefit your lawn because most of it will run off to your stream. You can measure how much you have watered by placing a rain gauge in the yard or by putting down a tuna can every time you run the sprinkler.

Finally, a lawn does not need to be watered in order to live, even during a drought. Turf lawns naturally go dormant during hot weather or drought. So while your lawn may turn brown it is still alive. If you have a healthy lawn it will retain more water in the soil and therefore it will be less susceptible to drought. During extended periods of drought, fescue and bluegrass lawns need about one and a half inches of water every two weeks to ensure that they recover when rain returns.

Weed Control:

A lawn does not have to be a weedy lawn; but it does take diligence and planning on the part of the homeowner. To control weeds, try the following measures:

Roundup™ is toxic to fish and should not be used where it will come in contact with water.

1. Begin attacking weeds when they first appear.
2. Learn to identify the weeds in your lawn.
3. Learn their life cycles—there are perennials, biennials, and annuals.
4. Mow before weeds flower.
5. Bag clippings only when weeds are flowering or in seed.
6. Pull, dig, or hoe weeds often, it works!

Weeds grow in spots that grass can't handle. Areas that are too shady, wet, dry, compacted, under fertilized, over fertilized, or are mown too close are all ideal spots for weeds in your yard. Correct these problems and you'll erase most of your weed problem without ever having to spray synthetic herbicides.

Weeds are defined as grassy or broadleaf (nongrass weeds), and may be annuals, perennials, or biennials. They are also designated as warm-or cool-season. It is important that you find out exactly what weeds you have before you begin any treatments.

It's important to understand that some herbicides can slow the biological activity in the soil, weakening grass plants. Applying herbicide to an entire lawn when only one or two sections have problems can place the entire lawn at risk for other problems.

Applying herbicides in anticipation of weeds makes even less sense. If you decide to use herbicides, use them sparingly and always ensure that the herbicide that you use will kill the weeds you wish to remove. The biggest mistake homeowners make is using the wrong product for a weed or using the right product at the wrong time in the plant's life cycle. Always apply the dosage on the label. More is never better.

There are organic weed control methods on the market. *Find a local* distributor or look on the Internet for a source. There are other methods you can use such as pouring boiling water onto weeds. However, this is imprecise and should be used only on areas where removal of all plants is desired. Additionally, there are many homemade remedies that are easy to make and use. Check your local library for a book on organic control methods.

Pest Control:

Perhaps the biggest battle that homeowners fight on the home front is pests, such as, insects and small rodents. We tend to reach for the big spray guns when combating small pests such as grubs, beetles, aphids, and spider mites. Did you know that homeowners apply pesticides (which include insecticides, herbicides and fungicides) at a rate greater than agricultural producers? Annually, homeowners in the U.S. apply 4 million pounds of 2,4-D (a herbicide) and 6 million pounds of diazinon (an insecticide) to lawns.

Pesticides are often used when the problem is actually caused by some cultural practice such as over watering or mowing too short. Just because we see a pest doesn't mean there is a problem, and even if a problem exists it doesn't mean the pest is the cause. Too often we reach for a pesticide without analyzing the actual cause of the damage. Also, many homeowners use pesticides even when no damage or pests are found as if they can prevent problems in the future! Never spray without first positively identifying your enemy and the damage it has caused. Never spray an entire lawn for pests that occur in only one portion of the lawn. Remember that improperly used pesticides can runoff into streams when it rains or lead to resistance by certain pests.

Table 2.5

Plants that Attract Beneficial Insects and Birds
Dogwood
Serviceberry
Viburnum
Queen Anne's Lace
Daisies
Caraway
Coriander
Fennel
Black-eyed Susans
Buttercups
Strawflowers
Sunflowers
Yarrow

Integrated pest management (IPM) is the best practice for home gardens, especially those that are close to streams. An environmentally sensitive approach to pest control, IPM relies on a combination of common sense practices. With IPM the emphasis is on using proper landscape management, pest resistant plants alternative, natural predators and, if required the application of least-toxic pesticides.

Set up a pest control system that relies on monitoring and prevention rather than blanket spraying for pests that may or may not be in your yard. Get to know your plants by walking your yard looking for evidence of pests so that you can resolve any problems before you need to resort to the use of commercial insecticides.

The best way to combat harmful insects is with natural predators, often other insects like ladybugs, lacewings and praying mantis. Bordering your lawn with native trees and plants will attract birds and insects that will keep harmful insect populations under control. Placing islands (flowerbeds) of flowering native plants within the lawn will also help. Beneficial insects will control bugs as much as 50 yards away from their favorite source of nectar.

There are simple and inexpensive practices that help in pest control. Often a spray of the hose can remove pests from plants. Soapy water is also very effective against harmful insects like aphids, earwigs, tent caterpillars, and

Table 2.6

Plants That Repel Pests	
Pest	**Plant**
Ant	mint, tansy, pennyroyal
Aphids	mint, garlic, chives, coriander, anise
Bean leaf beetle	potato, onion, turnip
Codling moth	common oleander
Colorado potato bug	green beans, coriander, nasturtium
Cucumber beetle	radish, tansy
Flea beetle	garlic, onion, mint
Imported cabbage worm	mint, sage, rosemary, hyssop
Japanese beetle	garlic, larkspur, tansy, rue, geranium
Leaf hopper	geranium, petunia
Mexican bean beetle	potato, onion, garlic, radish, petunia, marigolds
Mice	onion
Root knot nematodes	french marigolds
Slugs	prostrate rosemary, wormwood
Spider mites	onion, garlic, cloves, chives
Squash bug	radish, marigolds, tansy, nasturtium
Stink bug	radish
Thrips	marigolds
Tomato hornworm	marigolds, sage, borage
Whitefly	marigolds, nasturtium

The best maintenace you can do for your lawn is aeration. Aerating your lawn every few years will reduce soil compaction, improve drainage and make your lawn disease resistant. Use a corer type aerator, and leave the plugs on your lawn to break down.

leafhoppers. Some insects can simply be pulled off a plant and dropped in soapy water. Also, consider plantings that repel harmful insects or that attract beneficial ones. (See Table 2.5 for plantings that attract beneficial insects and Table 2.6 for those that repel harmful insects.)

There are other natural controls that can be bought at a garden center. Besides attracting birds to your yard, nematodes control grubs and cutworms. Try using milky spore on Japanese beetles. Specialty garden shops provide many other alternative products, such as hot pepper spray. You can even purchase beneficial insects for your yard.

Disease:

Lawns that are improperly managed become susceptible to disease, which is generally caused by fungal pathogens that live in the soil. In healthy soil these fungi are outnumbered by other beneficial microorganisms and are therefore kept in check. When chemical fertilizers and pesticides are over applied on a lawn, beneficial microorganisms are weakened and fungal pathogens can become a problem.

Since improper cultural methods cause disease, the best way to combat it is through proper lawn care techniques that were previously discussed in this text. If disease is causing a problem in your lawn:

- Avoid the temptation to use chemical fungicides
- Stop all chemical treatments to your lawn
- Increase microorganisms in your soil by top-dressing your lawn with compost, pessat moss or topsoil
- Apply seaweed, which contains hormones that fight fungus
- Aerate your lawn, it's the single best disease fighter

Yard Maintenance:

Even if organic lawn care techniques are used, damage to the stream can still occur if lawn clippings and other yard materials are not disposed of properly. Never dump grass or leaves on a streambank or in the stream channel. If you compost your yard waste make sure that the compost pile is 25 feet from the stream, so runoff doesn't flow directly into the stream. Compost contains nutrients that are good for our soil, but in excess they can cause damage to the water quality of our streams.

Leaves or grass clippings dumped into forested areas, especially on slopes, will cause erosion because they kill all the vegetation beneath the pile, which can take more than a year to decompose.

Avoid raking, sweeping, or blowing grass and leaves onto driveways, streets, or into stormdrains. They will end up in your stream. It is better to compost these materials and get their full nutrient benefit by returning them to your soil. Check to see if your community has a municipal compost program where you can take your yard materials. If not consider starting one.

Planting the Riparian Corridor

Undisturbed and Managed Forests:

Undisturbed and managed forests are similar in structure; the only difference is the restriction on activity within undisturbed forests. These forested areas provide stability for the stream to help preserve its natural characteristics. They also provide a connection to humans and their land uses near the steam.

Trees and shrubs provide soil stabilization, while increasing the water-holding capacity of the soil. This will allow for the storage and slow release of stormwater, while providing a root system that actively prevents erosion and protects the streambank.

The key to planting the riparian corridor is to optimize diversity. You want many different types of plants to recreate a forest environment. In nature, forests generally consist of three layers: a canopy made up of tall trees, an understory of shorter trees and shrubs, and a groundcover layer (see Figure 2.0). The understory layer is generally neglected in the urban environment because we tend to plant trees alone in the landscape. An understory layer

Table 2.7

Benefits of Vegetation

	Vegetation type		
Benefit	**Grass**	**Shrub**	**Tree**
Stabilize streambank	low/med	med/high	high
Filter sediment	high	low/med	high
Filter sediment bound nutrients, pesticides, microbes	high	low/med	high
Filter soluble nutrients, pesticides, microbes	med	low	med
Aquatic habitat	low	med	high
Wildlife habitat: range/pasture	high	med	low
Wildlife habitat: forest wildlife	low	med	high
Economic products	med	low/med	high
Flood protection	low	med	high

Source: USDA Forest Service/Natural Resource Conservation Service

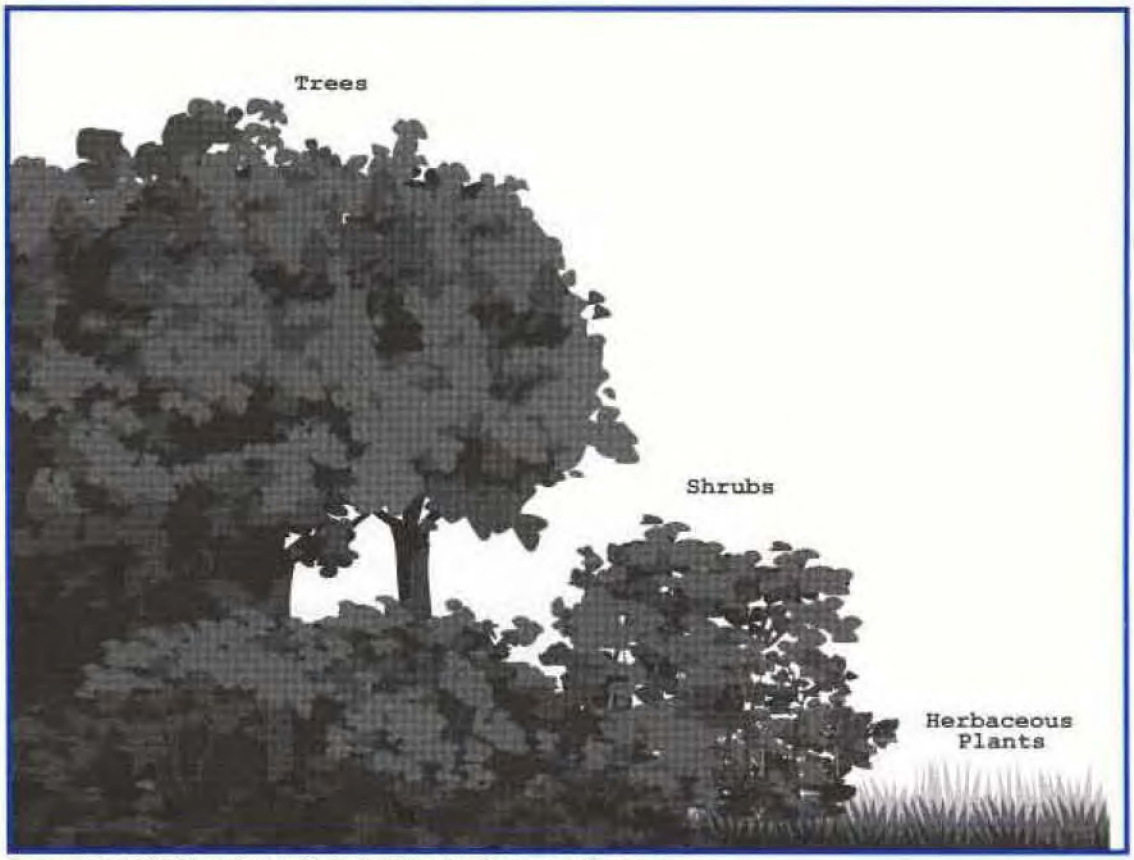
increases biodiversity in wildlife though the provision of much-needed habitat. It also protects water quality.

Diversity in types of plants, trees, and shrubs is important but diversity among different species within groups is also important. Planting several types of trees and shrubs will make your forest less susceptible to disease, as well as, provide greater protection for your streambank.

Different types of plants serve different functions (see Table 2.7 for benefits of vegetation types). This diversity will give your stream the greatest ability to respond to changes. When selecting trees and shrubs to plant, you will need to consider:

- Sun requirements
- Soil conditions
- Flood tolerance
- Growth rate
- Height at maturity
- Rooting habit
- Native species
- Temperature tolerance
- Wildlife benefits in food and shelter

Figure 2.0 Forest Canopy Diversity



Source: USDA NRCS Stream Corridor Restoration: Principles, Processes and Practices

You will want to select trees and shrubs that will tolerate the conditions you have along your section of the stream. This is the most important condition that they must meet. Additionally, you should choose trees and shrubs because they provide shelter and food for animals or they improve water quality.

Fast growth trees establish quickly and are good for an area that has recently been disturbed; however, they also tend to be short lived so you want to also select some slow-growth species that will live longer. This will give your corridor stability into the future. You don't want all your trees to die at once because that would leave your stream unprotected and susceptible to erosion.

Shallow-rooted trees hold surface soils but do not provide stability to high streambanks and steep slopes. It is best to plant a variety of deep- and shallow-rooted trees. In areas where there is repeated flooding followed by long dry periods use deep-rooted trees.

Another thing to consider is whether the trees will provide shade to the stream when they reach their mature height. Shading the stream cools the water temperature and allows aquatic life to flourish. A shaded stream will improve water quality as well. Ideally, trees will stretch across the stream from both sides to provide full shade along the length of the stream.

Invasive Non-native Species:

In some instances these plants can actually choke out native species, impede stream flow, and contribute to flooding. Invasive plants also have little or no habitat value for wildlife. Yet mowing, clearing, or stripping away non-native vegetation can promote erosion. Seek professional advice before removing invasive species, and replace with native vegetation as soon as possible. Vines, such as kudzu, Virginia creeper and wild grape, can especially be a problem along streams where they become prolific and weight down trees, often killing them.

Planting the Streambank:

Planting your streambank can be expensive and time consuming, so you want to do the job right the first time. There is much information that you need to gather prior to planting. Take the following steps before you start any project:

1. Contact one of the agencies recommended in the appendix before starting any project.
2. Contact local agencies to see if a permit is required.
3. Establish the normal, high, and low water elevations.
4. Know the seasonal changes in water elevation.
5. Find out how rapidly the elevation changes.
6. Determine the normal and high stream velocity.

Vegetation on your streambank is your first line of defense against streambank erosion; however, it will not solve all problems. If your streambank is failing because of a high water table, landslide, or a degrading

stream bottom (stream is digging deeper), plantings on the streambank will not help solve the problem.

You will definitely need professional help if your streambank is greater than 3 feet in height or the stream velocities are greater than 3 - 5 feet per second. Additionally, plantings should not be attempted if the soil or water is contaminated with heavy metals or chemicals from industrial processes.

Steps you can take to ensure that you have a successful project include:

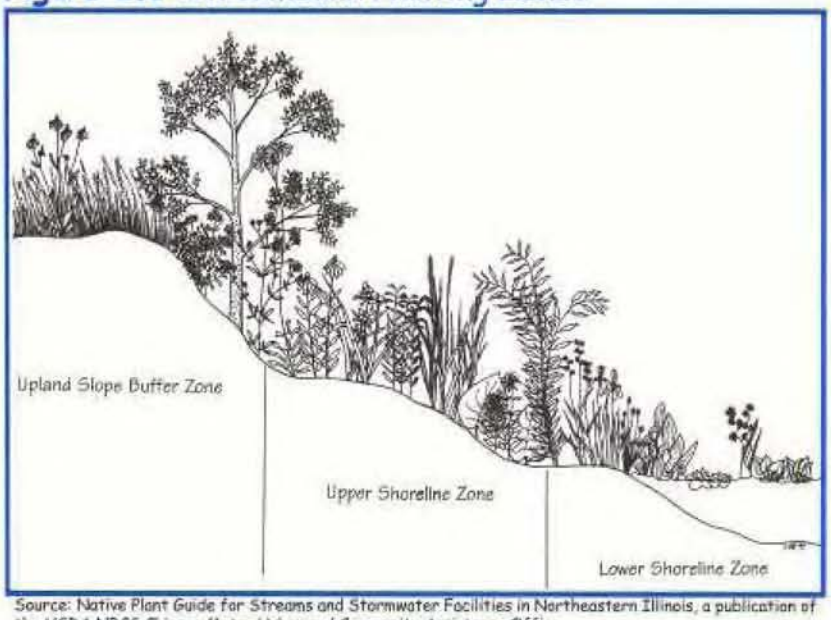
1. Planning ahead by consulting with the proper professionals.
2. Selecting plants that are appropriate for your site conditions.
3. Fencing out animals and people while the site is establishing itself.
4. Being aware of potential flood or drought conditions that may occur.
5. Monitoring your site regularly.
6. Providing needed maintenance and supplemental plantings.

Streambank Planting Zones:

Like the riparian corridor, the streambank can be broken down into three zones: toe, splash, and upland. The exact size of each of these zones depends on the normal, high, and low water elevations of your stream. Plants experiencing too much or too little water will not thrive, so your selections must be informed.

The toe is where the streambank meets the stream channel. Plantings here will experience wet conditions and will need to be able to handle frequent and extended periods of standing or flowing water. In some streams that have a flow most of the year, you may want to have plantings that require wet conditions. In the splash zone plants will be subjected to standing water part of the time or frequent wet conditions. In contrast, upland zone areas are drier and are rarely wet for any period of time. Plants used in this zone are least likely to tolerate extended periods of submergence. Planting recommendations for each

Figure 2.1 Streambank Planting Zones



Source: Native Plant Guide for Streams and Stormwater Facilities in Northeastern Illinois, a publication of the USDA NRCS Chicago Metro Urban and Community Assistance Office

zone are in Appendix B.

The Transition Zone:

This zone is immediately adjacent to your lawn and is closest to your home. It will act as a filter strip to absorb runoff from your yard before it reaches the creek. This transition zone should be planted with native grasses and wildflowers that are well adapted to your site conditions. Select plants on the basis of soil type, drainage, and sun requirements.

Native grasses and wildflowers are drought tolerant and able to deal with the extreme weather fluctuations of cold winters and hot summers here in Missouri. Once established they will not need additional inputs of fertilizer or water, and they will be resistant to pests and disease.

There are many benefits to planting a transition zone of native plants and native (warm-season) grasses. Native grasses and plants:

- Have deep, strong roots that hold soil
- Provide wildlife habitat throughout the year
- Grow on low-fertility sites
- Increase water infiltration
- Filter sediments, nutrients, pesticides, and microbes in runoff

Native grasses, which don't start their growth until warmer weather, are slower to establish than cool-season grasses. This is because they are establishing an extensive root system in their first year. They will need at least two years to establish, and competition from weeds and cool-season grasses must be kept to a minimum. Native grasses cannot be sown directly into an area that is made up of cool-season grasses. The cool-season grass must first be killed off.

The best time to plant native grasses is in the late spring, from May to the end of June. This gives more time for soil preparation and weed control. The disadvantage is that there is an increased chance of drought conditions. Be prepared to water your grass for the first season.

To prepare the site, all vegetation must be removed prior to seeding. This can be done with the use of herbicides, there are organic herbicides available. Alternatively, you can place black plastic over the area in the fall prior to planting. Allow at least six weeks to kill all the vegetation. In the late spring till the soil enough to loosen the top two to three inches and allow good contact of the seed with the surface. Deep tilling will bring up weed seeds so you want to careful not to till too deeply. Be sure that you buy top quality seed that has been cleaned. Use a broadcast type seed spreader. Seeds should be rolled lightly after seeding to ensure good contact with the soil.

Cool-season grass starts its growth around March in Missouri, and will tend to slow down growth in the hotter months, only to have another growth spurt in the cooler fall months. Because of this, they are strong competitors against native grasses and need to be controlled. Mowing early in the season, before the native grass seed has really started growth, is very important. Cut back mowing in June, July, and August when native grasses are at their peak

growth rate. Control weeds by mowing the stand no lower than 4 to 6 inches in the first year. If wildflowers are included in your mixture do not mow the stand lower than 8 to 12 inches. Do not let weeds get more than 12 inches high before mowing.

If your community has ordinances against long grass or 'weeds' talk to them about why you are growing tall grasses, and ask if they will change the ordinances so that your stream can be properly maintained. Alternatively, you can place a border to the front of the planting. A border will give the planting a neater edge so that it looks like a typical flower garden planting. Usually this makes the taller plants more acceptable to those who complain.

Once your grass and wildflower plantings have become established in the second year, the best management practice is controlled burns. However, because this is not practical in a suburban setting you can maintain your stand by mowing, but you must be careful not to allow a layer of litter to build up. Mow at least one-third of the stand every year, and remove and compost the layer of litter that is created.

Recommended Reading:

Protecting Stream Flow.....

Preventing Stormwater Problems

Stormwater runoff that occurs within minutes of the first start of a rain is the main enemy of streams and the main cause of stream erosion problems (See Figure 3.0). As a watershed is developed, more and more land is covered with buildings and parking lots, driveways, sidewalks, and patios. Stormwater is often routed directly into the stream from stormdrains in streets and even from downspouts from rooftops. The water from these surfaces once soaked into the soil and made its way to the stream over a matter of days or was retained in the soil as reserve to be used by trees and other plants. Now it flows to the stream in a torrent, causing down cutting of the stream channel and bank erosion.

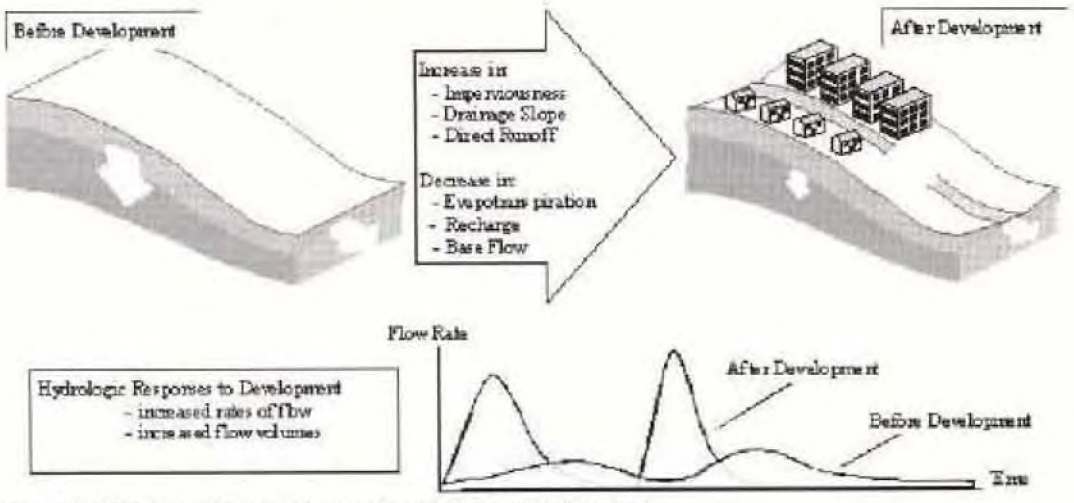
Most new developments are designed so that stormwater is moved quickly away from property, and streams become the convenient dumping zones. Instead of directing water flow from rooftops and sidewalks to grassed areas where infiltration can occur, it is directed onto paved surfaces that end at pipes in streams. Ways to correct this oversight on your property are discussed in this section.

Infiltration trenches:

The first place you can start is with your rooftop downspouts. Do they allow water to flow across your lawn in an even flow, or are they directed to the street or placed in a pipe that ends at your stream?

Directing your rooftop runoff to a grassy area or into a grass swale (swallow depression in the landscape used to convey water) can reduce runoff from your yard by 50%. There are several options. One is to simply let the water flow onto your lawn from the downspout. Ensure that the grading of your

Figure 3.0 *Changes in Runoff from Pre to Post Development*



Source: USDA NRCS "Stream Corridor Restoration: Principles, Processes and Practices"

land is such that the water is carried away from your house so that you don't incur a wet basement or foundation problem. The flow should not be concentrated but rather evenly distributed in a fan pattern so that erosion does not occur. Deal with any soggy areas of your lawn by planting wet-loving plants, such as sedges, rushes, and blue flag iris.

Another solution is to provide a trenched area such as a sand filter at each of your downspouts. These can be made from a variety of designs. The downspout empties onto a pre-cast latticed concrete paver. Beneath the paver is a bed of sand and gravel. Other filler materials to use are peat moss or compost over sand and gravel. A filter fabric lining is recommended to prevent soil from entering the system, filling in the spaces created by the gravel, thereby, plugging up the infiltration capacity of the filter.

Infiltration trenches can be installed along patios and driveways to take-up the excess runoff caused by these impervious surfaces. They should be inspected annually and after each rainfall because fine material tend to collect on the top and hamper infiltration.

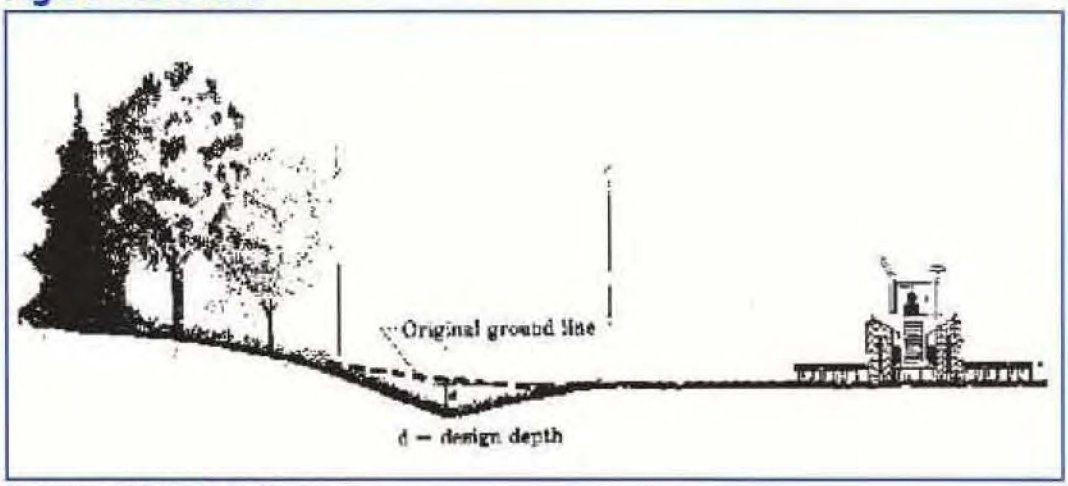
Terraces and Contours:

Yards adjacent to streams are often steeply sloped. This can create problems where overland water flow pours over the streambank, causing erosion. There are ways to increase infiltration and reduce overland flow on these yards. One solution is contouring, where landscape plants are planted along or with the slope instead of up and down the hill. You want to slow water flow as much as possible to encourage infiltration.

If your yard is steeply sloped and all water is directed downhill toward the stream you should consider breaking up the slope into a series of steps or terraces. Terracing on steep slopes will slow down water to allow infiltration.

One thing to remember, paths should never lead straight downhill because they will be an avenue for water to travel. Many garden paths, even those with steps, have become erosive areas of concentrated flow because they allow water to take a directed path downhill to the stream. Try to design paths to follow along the slope as much as possible.

Figure 4.0 *Swale*



Source: USDA NRCS Engineering Field Manual

Grass Swales and Diversions:

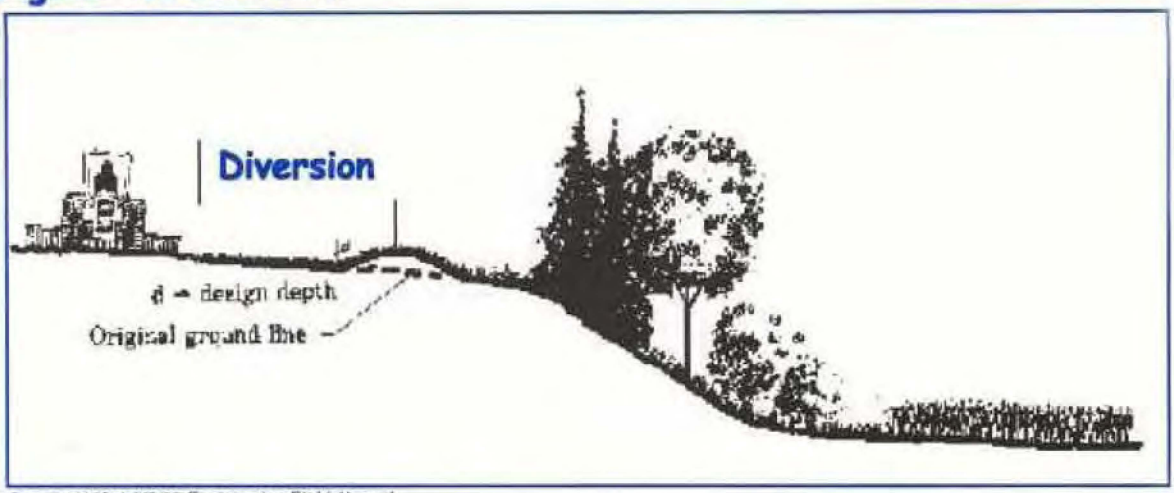
Grass swales and diversions convey water across property, slow down runoff, and allow for infiltration. A swale is an area of depression that collects and conveys water (see Figure 4.0). It can run with or against the slope. A diversion is a ridge with a channel that conveys water across the slope or on the contour of the slope to break the distance traveled (see Figure 4.1). A diversion is used to break up a long, steep slope and to take the water to a stable outlet such as a swale. If the yard is steeply sloped, a tile or pipe outlet should be used, but these are recommended only in cases where erosion would occur otherwise.

Many yards were originally designed with a system of swales, but homeowners often undermine them because they fail to understand their importance. Some have been replaced with plantings or they have been filled in because the owner didn't like having a depression in the yard. These changes alter the flow of water across the land and can contribute to streambank erosion if large amounts of water are allowed to spill over the banks. Aboveground pools, fences, planting beds, or structures should never block swales. The channel should be kept clear of all trees and shrubs. Grass clippings and other debris should be removed from the channel.

If your yard is steeply sloped down to the stream and water flows over the streambank causing erosion, you should consider installing a diversion along the slope to slow the flow and carry the water down to the stream. A system of swales in your yard will promote uniformly distributed flow, control erosion, and trap suspended solids in stormwater. Design specifications for diversions and grassed swales can be obtained by contacting your Soil and Water Conservation District and requesting urban design standards.

A professional should design diversions and grassed swales, and they should always outlet to a stabilized area. Stabilized areas for diversion and swale outlet include other swales; retention ponds; flat open expanses that are well vegetated; tile or pipe outlets designed by a registered design professional; and stormdrains. Using stormdrains or tile and pipe outlets as outlets is discouraged. They should be used only when erosion will occur without them.

Figure 4.1 Diversion



Source: USDA NRCS Engineering Field Manual

Reduce Impervious Surfaces:

Urban soils are highly compacted, poor in structure, and have low permeability because of the treatment they receive during construction. Their water infiltration rate is low so it is important that impervious surfaces be kept to a minimum.

Some ways to decrease the amount of impervious surface on your land, especially with new development include:

- Constructing driveways from asphalt or porous concrete
- Using interlocking, open-celled blocks over gravel for walkways or driveways
- Building wood decks with open-spaced floorboards
- Building patios with stones interplanted with moss or creeping thyme
- Mulching walkways with wood chips
- Making driveways of two parallel concrete tire runs

Preventing Flow Problems

Regular Stream Checks:

Get to know your stream thoroughly in all seasons of the year. Check for erosion regularly, at least after every major storm event, and correct problems promptly. Don't let a problem grow and threaten your property before you decide to act. (See Section One: Stream Health Diagnostics.)

When flowing water meets unprotected soil, erosion almost always results. Bare slopes on any portion of your property (not just streambanks) can lead to sedimentation problems in the stream. Revegetate a denuded area in your yard as quickly as possible, applying mulch as a top covering until the vegetation is able to establish itself.

Keep an eye on the bottom of the slope. A vegetated slope is the best defense against under-cutting and slumping banks. Replant bare slopes or disturbed soils as quickly as possible. On slopes that are not too steep, a covering of straw or other suitable mulch spread over newly bared earth will prevent erosion until vegetation can grow back.

Dumping leaves, grass clippings, tires, or slabs of concrete over the bank will usually cause more erosion rather than solving the problem. (See Section Five: Streambank Stabilization for effective streambank techniques.)

Stream Debris:

Removing branches, boulders, and dead vegetation from a stream can harm fish and wildlife. Natural debris provides food and cover for fish, aquatic insects, and other animals. It also provides a feedback loop where fallen debris caused by fast water serves to slow the current's flow and provides pools.

If debris poses a serious flooding or erosion hazard then careful selected removal may be necessary. Seek advice from the Missouri Department

of Conservation before removing any debris from a stream (see Appendix for phone numbers). Never dislodge debris and leave it in the stream to be carried away by the next storm event. This only causes problems elsewhere in the system.

The safest approach to good stream care is to avoid altering the watercourse unless the modification is needed to resolve an existing bank problem. It is best to seek advice from the appropriate agencies before taking any action yourself.

Structures:

The best way to accommodate floodwaters is to avoid constructing improvements in the flood zone and to actively maintain the natural state of the area. In most municipalities, streams have setbacks that require structures be kept a minimum distance from the stream. Structures such as storage sheds, patios, and decks require removal of the stream's natural protective vegetation and often decrease the stability of vulnerable slopes. Compost piles, garbage cans, or dumpsters should not be located where runoff can flow directly into the stream.

Watershed Action

One landowner can make a difference on his or her own property. However, the problems seen in the stream are most often symptoms of changes or actions taking place elsewhere in the watershed. To bring about real change, and to protect your property from further degradation, you will need to become organized and active on a watershed basis.

Watershed partnerships have been successful across the country in protecting rivers and streams, in restoring riparian corridors, and in improving water quality. Many urban streams have been rehabilitated and restored through such efforts.

Watershed partnerships seek to include all the people who interact within a watershed. These people are called stakeholders because they have an interest in what happens in the watershed. Stakeholders include:

- Homeowners
- Landowners
- Developers
- Recreational users
- Elected officials
- Planning and zoning committees
- Media
- Educators
- Community groups
- Youth groups
- Real estate agents
- Local businesses

- Federal and state natural resource agencies
- Soil and water conservation districts
- Nonprofit natural resource agencies

Remember that a watershed knows no political boundaries so people from different towns, counties and even states may need to be informed and included in your group. If you are interested in taking part in a watershed partnership contact your local Soil and Water Conservation District for further information. Some of the many actions that can be taken to protect streams include:

- Advocating stormwater ordinances to ensure that new developments handle their runoff on-site and that they do not alter the discharge rate to the stream
- Encouraging ordinances with wider riparian corridors
- Discouraging development within the corridor
- Encouraging the minimization of impermeable surfaces
- Advocating sediment/erosion control and tree protection ordinances
- Eliminating curbing to reduce non-point source pollution
- Incorporating retention basins into existing developments
- Discouraging stream channelization
- Ensuring that existing retention basins are maintained
- Encouraging enforcement of existing and new ordinances
- Advocating the creation of riparian corridor greenways
- Encouraging ordinances that prohibit development in the floodplains

Another way to bring about change is to form a Missouri Stream Team for your stream. Stream Teams take part in many activities in the watershed. Their activities include litter pick-up, tree planting, water quality testing, educational programs, workshops, and even streambank stabilization projects. If you are interested in forming a Stream Team see the contact information in Appendix C. All stream team members receive training on monitoring techniques. Additionally, equipment is supplied for monitoring water quality.

Streambank Stabilization.....

Streams are complex, interconnected systems that are always in flux. Working in the riparian corridor, especially on streambanks or in the stream channel, requires extensive knowledge and expertise. Any work within a stream must be based on information not only about the stream but also about the surrounding watershed. Actions taken to protect your streambank may have unforeseen consequences downstream — you may unintentionally pass your erosion problems onto your neighbor's property.

Streams are constantly reshaping their channels through natural processes—scouring outside curves and depositing sediment inside bends in the waterway. A stream's natural tendency to meander can be aggravated by human activities throughout the watershed. Increased volumes of stormwater runoff into streams, removal of natural vegetation, and upstream alteration of the channel can lead to erosion problems on banks that were once stable. Unstable banks in turn can lead to extensive bank failures and add large volumes of sediment to the stream, resulting in property loss.

If you have a serious erosion problem, consult with a qualified professional in bank stabilization and stream restoration. Check with one of the offices listed in Appendix C. You may need to obtain a permit as well. Some municipalities have local stream ordinances with which you must comply.

Bank Stabilization Techniques

Bioengineering is an old science that is coming back into use. It combines structures, often created from dead organic matter, with live vegetation to provide slope stabilization, erosion control, streambank protection, and create barriers for noise reduction. Bioengineering creates living systems that function to provide stabilization while improving water quality and providing wildlife and aquatic habitat.

The method dates back to the 12th century in China where brush bundles were used to stabilize slopes. Since that time, bioengineering methods have been used extensively by the USDA in agricultural regions. They are now making a comeback in urban areas to provide much-needed, cost-effective, environmentally friendly solutions to stream problems.

Traditionally, stream problems have been solved with concrete, rip rap (layers of rock on banks), or retaining walls. These solutions are expensive, often ineffective, and definitely harmful to the environment. Besides being unsightly, they destroy wildlife and aquatic habitat, decrease water quality, and often create further problems within the stream system.

This guide highlights a few bioengineering methods that can be used successfully in an urban area. Any bioengineering project relies on a team of experts that usually includes stream geomorphologists, civil engineers, soil scientists, horticulturists, botanists, and construction contractors. To find out if your stream could be improved through bioengineering, contact one of the

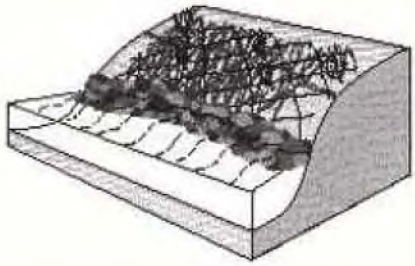
agencies listed in Appendix C.

Information on the bioengineering techniques described here was taken directly from the USDA Natural Resources Conservation Service National Engineering Handbook "Stream Corridor Restoration: Principles, Processes and Practices." The manual is available on-line at the USDA website: www.usda.gov.

Brush Mattresses: Applications and Effectiveness

- Form an immediate protective cover over the streambank.
- Capture sediment during flood flows.
- Provide opportunities for rooting of the cuttings over the streambank.
- Rapidly restore riparian vegetation and streamside habitat.
- Enhance conditions for colonization of native vegetation.
- Limited to the slope above base flow levels.
- Toe protection is required where toe scour is anticipated.
- Appropriate where exposed streambanks are threatened by high flows prior to vegetation establishment.
- Should not be used on slopes that are experiencing mass movement or other slope instability.

Brush Mattresses

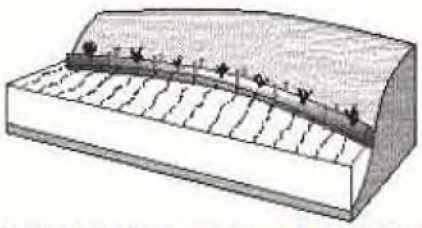


Combination of live stakes, live facines, and branch cuttings installed to cover and physically protect streambanks; eventually to sprout and establish numerous individual plants.

Coconut Fiber Log: Applications and Effectiveness

- Most commonly available in 12 inch diameter by 20-foot lengths,
- Typically staked near the toe of the streambank with dormant cuttings and rooted plants inserted into slits cut into the rolls.
- Appropriate where moderate toe stabilization is required in conjunction with restoration of the streambank and the sensitivity of the site allows for only minor disturbance.
- Provide an excellent medium for promoting plant growth at the

Coconut Fiber Roll



Cylindrical structures composed of coconut husk fibers bound together with twine woven from coconut material to protect slopes from erosion while trapping sediment which encourages plant growth within the fiber roll.

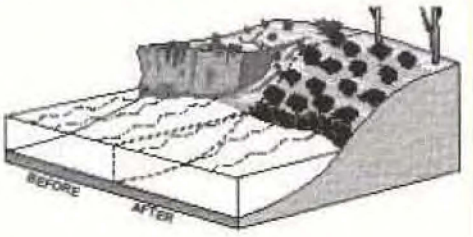
water's edge.

- Not appropriate for sites with high velocity flows or large ice build-up.
- Flexibility for molding to the existing curvature of the streambank.
- Requires little site disturbance.
- The rolls are buoyant and require secure anchoring.
- Can be expensive.
- An effective life of 6 to 10 years.
- Should, where appropriate, be used with soil bioengineering systems and vegetative plantings to stabilize the upper bank and ensure a regenerative source of streamside vegetation.
- Enhances conditions for colonization of native vegetation.

Bank Shaping and Planting: Applications and Effectiveness

- Most successful on streambanks where moderate erosion and channel migration are anticipated.
- Reinforcement at the toe of the embankment is often needed.
- Enhances conditions for colonization of native species.
- Used in conjunction with other protective practices where flow velocities exceed the tolerance range for available plants, and where erosion occurs below base flows.
- Streambank soil materials, probable groundwater fluctuation, and bank loading conditions are factors for determining appropriate slope conditions.
- Slope stability analyses are recommended.

Bank Shaping and Planting

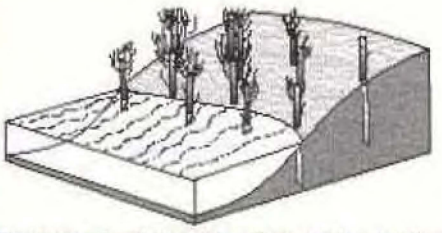


Re-grading streambanks to a stable slope, placing topsoil and other materials needed for sustaining plant growth, and selecting, installing and establishing appropriate plant species.

Dormant Post Plantings: Applications and Effectiveness

- Can be used as live piling to stabilize rotational failures on streambanks where minor bank sloughing is occurring.
- Useful for quickly establishing riparian vegetation, especially in arid regions where water tables are deep.
- Will reduce near bank stream velocities and cause sediment deposition in treated areas.
- Reduce streambank erosion

Dormant Post Planting



Plantings of cottonwood, willow, poplar, or other species embedded vertically into streambanks to increase channel roughness, reduce flow velocities near the slope face, and trap sediment.

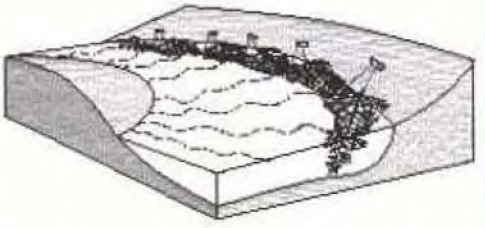
by decreasing the near-bank flow velocities.

- Generally self-repairing and will restem if attacked by beavers or livestock; however, provisions should be made to exclude such herbivores where possible.
- Best suited to non-gravelly streams where ice damage is not a problem.
- Will enhance conditions for colonization of native species.
- Are less likely to be removed by erosion than live stakes or smaller cuttings.
- Should, where appropriate, be used with soil bioengineering systems and vegetative plantings to stabilize the upper bank and ensure a regenerative source of streamside vegetation.
- Unlike smaller cuttings, post harvesting can be very destructive to the donor stand, therefore, they should be gathered as 'salvage' from sites designated for clearing, or thinned from dense stands.

Tree Revetment: Applications and Effectiveness

- Design of adequate anchoring systems is necessary.
- Wire anchoring systems can present safety hazards.
- Work best on streams with streambank heights under 12 feet and bank-full velocities under 6 feet per second.
- Use inexpensive, readily available materials.
- Capture sediment and enhances conditions for colonization of native species particularly on streams with high bed material loads.
- Limited life and must be replaced periodically.
- Might be severely damaged by ice flows.
- Not appropriate for installation directly upstream of bridges and other channel constrictions because of the potential for downstream damages should the revetment dislodge.
- Should not be used if they occupy more than 15 percent of the channel's cross-sectional area at bank-full level.
- Not recommended if debris jams on downstream bridges might cause subsequent problems.
- Species that are resistant to decay are best because they extend the establishment period for planted or volunteer species that succeed them.
- Requires toe protection where toe scour is anticipated.
- Should, where appropriate, be used with soil bioengineering systems and vegetative plantings to stabilize the upper bank and ensure a regenerated source of streamside vegetation.

Tree Revetments



A row of interconnected trees attached to the toe of the streambank or to deadmen in the streambank to reduce flow velocities along eroding streambanks, trap sediment, and provide a substrate for plant establishment and erosion control.

Appendix A

Glossary

Algae: A chlorophyll-containing plant ranging from one to many cells in size that lives in fresh- or salt-water.

Annual: A plant that lives for one year or one growing season.

Aquatic Insect: Insect species whose larvae and juvenile forms live in the water.

Aquifer: Any underground geological formation containing water.

Bedrock: Unbroken solid rock, overlain in most places by soil or rock fragments.

Beneficial Landscaping: Using different landscaping techniques to achieve all kinds of benefits (e.g., decrease maintenance costs, reduce storm-water runoff, beautify the land, preserve endangered species, etc.).

Benthic: Bottom-dwelling plant and animal life whose habitat is the bottom of a sea, lake or river.

Biennial: A plant that grows from seed and produces leafy growth the first year and in the second year produces flowers, seeds, and then dies.

Biodiversity: A measurement of the number of species and the variety of life and its processes in an area.

Bioengineering: The use of vegetation for civil engineering purposes, such as slope stabilization, erosion control, shoreline protection, barriers for noise reduction, etc.

Buffer/Buffer Strip: A management area closest to a sensitive environmental site (e.g., wetland, waterbody, etc.) in which human activities are prohibited or limited in order to minimize the negative impacts from adjacent land uses (like erosion, pollutants in runoff, disturbance to wildlife) affecting the sensitive environmental site.

Channelized: The straightening and deepening of streams. Channelization reduces the ability of the stream to assimilate waste and disturbs fish breeding areas.

Clarity: The clearness of the water in the stream.

Conifers: A cone-bearing evergreen tree or shrub (a pine tree, for example).

Cover: Overhanging or instream structures (such as tree roots, undercut streambanks, or boulders) that offer protection from predators, shelter from strong currents, and/or shading.

Current: The velocity (speed) of the flow of water.

Deciduous: A tree or shrub that sheds its foliage at the end of the growing season.

Ecosystem: A community of plants and animals interacting with each other and their physical/chemical environment.

Effluent: The wastewater from a municipal or industrial source that is discharged into the water.

Emergent: Pertaining to aquatic plants that have some portion of the plant partly into the water, or floating on top or above the water.

Erosion: The wearing away of the land surface by wind or water.

EPA: Environmental Protection Agency.

Appendix A

Exotic Species: A non-native plant or animal introduced from another geographic area.

Filling: The process of depositing dirt and mud in marshy areas (wetlands) or in the water to create more land. Filling disturbs natural ecological cycles.

Forb: Any herbaceous plant that is not a grass.

Gabion: A sustaining wall of rocks used to replace eroded streambank.

Gradient: The slope, or steepness, of the stream.

Greenway: A corridor of open land that provides one or more of the following benefits: (1) protection and management of natural and cultural resources; (2) provision of recreational opportunities; and (3) enhancement of the quality of life and the aesthetic appeal of neighborhoods and communities.

Groundwater: The supply of freshwater under the earth's surface in an aquifer or soil.

Habitat: The specific environment in which an organism lives and on which it depends for food and shelter.

Headwaters: Small creeks at the uppermost end of a stream system often found in the mountains that contribute to larger creeks and rivers.

Herbaceous Plant: Any plant that is not woody.

Leach: To dissolve and wash away by a percolating liquid.

Monitor: To measure a characteristic, such as streambank condition, dissolved oxygen, or fish population, using uniform methods to evaluate change over a given period.

Native Landscaping: Landscaping using only native plants.

Native Species: A plant or animal that originated in a given area.

Nonpoint Source Pollution: Diffuse pollution generated from large areas with no particular point of pollutant origin, but rather from many individual places. Urban and agricultural areas generate nonpoint source pollutants.

Nutrient: Any substance, such as fertilizer, phosphorus, and nitrogen compounds that enhances the growth of plants and animals.

Perennial Plant: *A* plant that lives for more than two years.

Point Source Pollution: A discharge of water pollution to a stream or other body of water, via an identifiable pipe, vent, or culvert.

Pool: An area of relatively deep, slow water in a stream that offers shelter to fish.

Reach: A stream section with fairly homogeneous characteristics.

Riffle: A shallow, gravelly area of streambed with swift current. Used for spawning by fish.

Riparian Area: An area adjacent to and along a waterbody often vegetated and constituting a buffer zone between the nearby lands and the watercourse.

Riparian or Stream Corridor: The lower and upper banks of a perennial or intermittent stream.

Riprap: Rocks used to line the shore of a lake or to cover a streambank.

Run: A stretch of fast smooth current, deeper than a riffle.

Appendix A

Runoff: The portion of stormwater, melted snow, or irrigation water that flows across the ground surface and is eventually returned to streams. Runoff can pick up pollutants from the air or the land and carry them to streams, lakes, and oceans.

Sediment: Fine soil or mineral particles that settle to the bottom of the water or are suspended in it.

Setback: Area between intensive development (i.e., structures) and a protected area (e.g., waterbody or wetland).

Stolon: A stem growing along or under the ground and taking root at the nodes or apex to form new plants.

Stormwater Detention Basin: A water body designed to detain stormwater runoff and reduce flooding.

Stormwater Runoff: Water that washes off the land after a rainstorm. In developed watersheds, it flows off roofs and pavement into storm drains that may feed directly into the stream; often carries concentrated pollutants.

Stream Mouth: The place where a stream empties into a lake, ocean, or another stream.

Submergent: Aquatic plants that live and grow entirely below the water surface.

Substrate: The material that makes up the bottom layer of the stream, such as gravel, sand, or bedrock.

Suspended Sediments: Fine material or soil particles that remain suspended by the current until deposited in areas of weaker current. They create turbidity and when deposited can smother fish eggs. Can be measured in a laboratory as "Total Suspended Solids" (TSS).

Thatch: A layer no thicker than 1/4" of clippings and stems that gradually decompose and feed the roots. Thatch becomes a problem when the layer builds up and does not break down naturally.

Topographic: The configuration of a surface area including its relief, or relative elevations, and the position of its natural and man-made features.

U.S.G.S.: U.S. Geological Survey.

Velocity of flow: The speed that the water travels at.

Watershed: An area surrounding and 'shedding' water into a common water body, such as a stream, river, lake or wetland.

Weed: Any undesirable or troublesome plant, especially one that grows profusely where it is not wanted.

Wetlands: Land areas where saturation with water is the dominant factor determining the nature of soil development. They also can be identified by unique plants, which have adapted to oxygen-deficient (anaerobic) soils. Wetlands influence stream flows and water quality.

Zoning: To designate by ordinances areas of land reserved and regulated for specific uses, such as residential, industrial, or open space.

Appendix B

Plant Lists.....

Plants for Streambanks in the Midwest			
Botanical Name	Common Name	Light Requirement	Preferred Zone
Cephalanthus occidentralis	Buttonbush	Sun to shade	Toe to splash
Cornus racemosa	Gray dogwood	Sun to shade	Splash to upland
Cornus sericea	Redosier dogwood	Partial shade	Splash
Salix spp including S. purpurea and S. cotetii	Shrub willows	Full sun	Toe to splash
Acer rubrum	Red maple	Full Sun	Splash to upland
Plantanus occidentalis	Sycamore	Full sun, seedlings can be started in shade	Toe to splash
Viburnum spp especially V. prunifolium and V. dentata	Viburnum	Partial shade	Splash to upland
Hamammelis virginiana	Witch hazel	Sun to shade	Splash to upland
Iris pseudocorus	Yellow flag iris	Full sun	Toe
Iris versicolor	Blue flag iris	Full sun	Toe
Carex spp.	Sedges	Sun to partial shade	Toe to splash
Scirpus spp.	Rushes	Sun to partial shade	Toe

Information provided by Intuition and Logic, a St. Louis engineering consulting firm.

*See Streambank Plant Comments on page 44 for additional details.

Appendix B

Streambank Plant Comments	
Botanical Name	**Comments**
Cephalanthus occidentralis	Tolerates extended inundation, establishes quickly, lovely form and flower. Okay on upland sites with adequate water.
Cornus racemosa	Fibrous roots, tough and adaptable, berries, excellent food source for birds, good fall color.
Cornus sericea	Highly stoloniferous, excellent thicket former, not drought tolerant.
Salix spp including S. purpurea and S. cotetii	Establishes quickly, highly stoloniferous, shrub species rarely exceed 12-15 feet.
Acer rubrum	Origin especially important for hardiness, locally acquired trees are tough and adaptable.
Plantanus occidentalis	Very large at maturity, fast growing, deep arching roots are excellent stabilizers, good canopy tree over dogwoods and other fibrous root understory trees.
Viburnum spp especially V. prunifolium and V. dentata	Excellent mid-sized to large understory shrubs that adapt to a wide range of sun and moisture conditions, with berries that are a good source of food for wildlife.
Hamammelis virginiana	Highly adaptable, good understory shrub with fragrant blooms in late fall.
Iris pseudocorus	Plant has vigorous, tough rhizomes with excellent soil-holding ability and superb flowers.
Iris versicolor	Plant is not quite as vigorous or showy as yellow flag but is still very good.
Carex spp.	Many excellent species of varying heights, sun and moisture requirements.
Scirpus spp.	Many fine species, most are quite large, and provide excellent scour protection and are resistant to goose predation.

Appendix B

Riparian Understory Trees and Shrubs

Species	Light	Flood Tolerance	Growth Rate	Deciduous/ Evergreen	Root System
Arrowwood viburnum	F/PS	Medium	Medium	Deciduous	Shallow
Blackhaw	F/PS	High	Medium	Deciduous	Shallow
Buttonbush	F/PS	High	Medium	Deciduous	Shallow
Common ninebark	F	High	Fast	Deciduous	Shallow
Elderberry	F/PS	High	Fast	Deciduous	Shallow
Grey dogwood	F/PS	Low	Medium	Deciduous	Shallow
Highbush blueberry	F/PS	High	Slow	Deciduous	Shallow
Possumhaw	F/PS	High	Medium	Deciduous	Shallow
Pussy willow	F	Medium	Fast	Deciduous	Shallow
Red chokeberry	F/PS	High	Slow	Deciduous	Shallow
Red osier dogwood	F/PS	High	Fast	Deciduous	Shallow
Silky dogwood	F/PS	Medium	Fast	Deciduous	Shallow
Spicebush	PS/S	Medium	Fast	Deciduous	Deep lateral
Winterberry	F/PS	High	Slow	Deciduous	Shallow
Witch hazel	F/PS	Low	Medium	Deciduous	Deep lateral
Hop hornbeam	F/PS	Low	Slow	Deciduous	Shallow
Flowering dogwood	F/PS/S	Low	Slow	Deciduous	Shallow
Hawthorn	F	Low-medium	Medium	Deciduous	Shallow
Pawpaw	PS/S	Low-medium	Slow	Deciduous	Deep lateral
Persimmon	F	Medium	Slow	Deciduous	Deep taproot
Redbud	PS	High	Slow	Deciduous	Shallow
Sassafras	F	Low	Fast	Deciduous	Shallow
Shadbush	PS/S	High	Slow	Deciduous	Shallow

F = FULL SUN, PS = PARTIAL SHADE, S = SHADE

Appendix C

Where to Call.....

Working in Your Stream:

- Call your local city or county public works or planning department to find out about local regulations, ordinances, and permits before undertaking any work in your stream.

- US Army Corps of Engineers—You may need a permit before you can do work in your stream. Check with the Corps before putting anything in or taking anything out of any water or wetland (314) 331-8575.

  Department of the Army St. Louis District, Corp of Engineers
  1222 Spruce Street
  St. Louis, MO 63103-2833
  www.mvs.usace.army.mil/

Reporting Spills and Illegal Discharges:

- Report suspected water quality problems to MODNR (314) 301-7100.

  Missouri Department of Natural Resources
  10805 Sunset Office Drive
  Suite 100
  St. Louis, MO 63127

- Report sewage spills to MSD (314) 768-6260.
- Report fish kills to the MDC (636) 441-4554.

Household Solid and Hazardous Waste Management:

Throughout the county hazardous waste material pick-up days are held. Call the numbers below for information about those dates. Additional information on handling materials and drop off sites is also available at these numbers. A recycling guide for the St. Louis area is also available on the Internet at: www.postnet.com

- MODNR (314) 301-7100
- St. Louis County Recycling (314) 286-9200
- MSD (314) 768-2727

Plant and Landscape Information:

- Master Gardeners' horticulture answer service (314) 577-5143.
- Kemper Center for Home Gardening (314) 577-9440.
- Hortline (a 24-hr. pre-recorded garden information service) (314) 776-5522.

Appendix C

- MDC tree seedling purchases (314) 301-1500.
- University Outreach and Extension St. Louis County Office (314) 615-2911.
- For soil tests call:
- Kemper Center for Home Gardening (314)577-9440.
- University Outreach and Extension, St. Louis County, (314)615-2911.

Erosion Control and Storm Water Management:

Check with your municipality for any stormwater regulations that may apply to you when you are working in the stream or changing the drainage on your land.

- For information on stormwater regulations call MODNR (314) 301-7100.
- For technical advise on erosion and drainage problems, stormwater management, and sediment and erosion control ordinances call USDA NRCS (314) 453-9555 ext. 3.
- For water management on your land, including information on terraces, diversions and swales call SWCD (314) 453-9555 ext. 3.

Streambank Stabilization Recommendation:

- For a list of contractors, engineers, consultants, and erosion control product suppliers contact the SWCD (314) 453-9555 ext. 3.
- For stabilization recommendations call MDC (636) 441-4554
- For a blocked stream call MSD (314) 768-6260.

Watershed Efforts:

For watershed evaluation and planning advise call:

- USDA NRCS (314) 453-9555 ext. 3
- MDC (636) 441-4554 ext. 3
- MODNR (314) 303-7100
- To form a Stream Team call 1(800) 781-1989 or visit their website: www.mostreamteam.org

MSD - Metropolitan Sewer District
MDC - Missouri Department of Conservation
USDA NRCS - USDA Natural Resources Conservation Service
SWCD - Soil and Water Conservation District, St. Louis County
MODNR - Missouri Department of Natural Resources

Appendix D

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